Implementation of GB Interface using Internet Protocol

Kshipra Chowdhary
VIT, Pune
666-Upper Indiranagar,
Bibewadi, Pune-37

Indraneil Deshmukh
VIT, Pune
666-Upper Indiranagar,
Bibewadi, Pune-37

Sangeeta Kurundhkar
VIT, Pune
666-Upper Indiranagar,
Bibewadi, Pune-37

ABSTRACT
The GSM technology has lower data rate around 9.6kbps. Also it proves expensive for bursty traffic utilization. Therefore to enhance the data capacity of GSM and mitigate some of its limitations, mobile technology using general packet radio service (GPRS) has been developed. GPRS adds packet-switched capabilities to existing GSM and TDMA networks. The circuit-switched technology has a long and successful history but it is inefficient for short data transactions and always-on service. The packet switched technology has grown in importance with the rise of the Internet and Internet protocol (IP). The Gb interface carries the GPRS traffic and signalling between the GSM radio network (BSS) and the GPRS network. Frame Relay based network services is used for this interface. However because of congestion problem and the lower throughput, this interface has been implemented using internet protocol called as the Gb over IP. This paper discusses the basic architecture of GPRS, pooling concept and the implementation of the Gb interface using internet protocol. After implementation the data rate increases to few mbps. This can be achieved through increased capacity utilization,network-level redundancy, efficient mobility and simplified O&M.

Keywords
GPRS, IP, Gb over IP.

1. INTRODUCTION
In early 2000, only a small portion of GSM subscribers used data services because existing GSM systems do not support easy access, high data rate and attractive prices. GSM operators must offer better services to stimulate the demand. The solution is General Packet Radio Service (GPRS). GPRS reuses the existing GSM infrastructure to provide end-to-end packet-switched services. GPRS standardization was initiated by ETSI/SMG in 1994. The main set of GPRS specifications was approved by SMG #25 in 1997, and was complete in 1999. GPRS products were developed in 1999, and service deployment has been in progress. GPRS core network has also been developed with IS-136 TDMA systems, and is anticipated to evolve as the core network for the third generation mobile systems.

The Gb interface connects the BSS and the SGSN. It allows for the exchange of signalling information and user data. Many users are multiplexed on the same physical resource. Resources are allocated to the user only during activity periods; after these periods, resources are immediately released and reallocated to other users. This is in contrast to the GSM 'A' interface where one user has the sole use of a dedicated physical resource during the lifetime of a call. No dedicated physical resources are required to be allocated for signalling purposes. Signalling and user data are sent in the same transmission plane.

It is a system and method in a General Packet Radio Service (GPRS) network for automatically configuring Network Service Entity Identifiers (NSEIs) in a Base Station System (BSS) and Serving GPRS Support Node (SGSN) when the BSS is reconfigured.

The Gb interface between the BSS and the SGSN is modified to operate using the Internet Protocol (IP), and the BSS and the SGSN are configured to run on IP. Whenever a new Network Service Entity (NSE) is added to an existing BSS, or a new BSS is added to the network, the BSS automatically sends a modified Network Service (NS′)-Reset message to the SGSN requesting an NSEI. The SGSN dynamically allocates a free NSEI from a pool of NSEIs and sends it to the BSS. When an NSE is removed from the BSS, the BSS automatically sends a modified NS′-Reset message to the SGSN to free an NSEI. The SGSN de-allocates the NSEI, and returns the NSEI to the pool of free NSEIs. All related entries for Base Station System GPRS Protocol (BSSGP) Virtual Circuit Identifiers (BVCIs) under the de-allocated NSEI are also removed by the SGSN.

2. GPRS ARCHITECTURE
Figure-1 shows the GPRS network nodes and the corresponding interfaces, where SMS-related components and the Equipment Identity Register are not shown. In this architecture, MS, BSS, Mobile Switching Centre/Visitor Location Register (MSC/VLR) and Home Location Register (HLR) in the existing GSM network are modified.

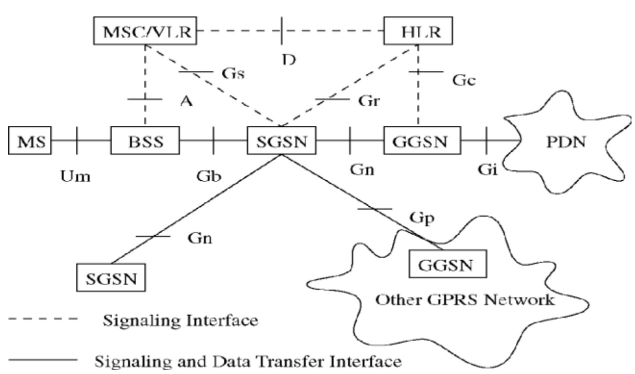

Fig 1: Basic GPRS architecture

The HLR is enhanced with GPRS subscriber information. Two new network nodes are introduced in GPRS. The Serving GPRS Support Node (SGSN) is the GPRS equivalent to the MSC. The Gateway GPRS Support Node (GGSN) provides interworking with external packet-switched networks, and is connected with SGSNs via an IP-based GPRS backbone network. The MS and the BSS communicates through the Um interface. The BSS and the SGSN are connected by the Gb interface with Frame Relay. Within the same GPRS network, SGSNs/GGSNs are connected through the Gn Interface. When SGSN and GGSN are in different GPRS networks, they are interconnected via the Gp interface. The GGSN connects to the external networks through the Gi interface. The MSC/VLR communicates with the BSS using the existing GSM A interface, and with the SGSN using the Gs interface. The HLR connects to SGSN with the Gr interface and to GGSN with Gc interfaces. Both Gr and Gc follow GSM Mobile Application Part (MAP) protocol defined in GSM 09.02 [4]. The HLR and the VLR are connected through the existing GSM D interface. Interfaces A, Gs, Gr, GC, and D are used for signalling without involving user data transmission in GPRS. Note that the A interface is used for both signalling and voice transmission in GSM. Interfaces Um, Gb, Gn, Gp and Gi are used for both signalling and transmission in GPRS.

2.1 GPRS in BSS

GPRS uses the radio interface efficiently in two ways. Firstly, it enables a fast method for reserving radio channels. Secondly, the benefit of GPRS is the sharing of resources with circuit switched connections. GPRS packets can be transmitted in the free periods between circuit switched calls. Furthermore, GPRS provides immediate connectivity and high throughput. The main functions of the BSC with GPRS are to:

- manage GPRS-specific radio network configuration
- control access to GPRS radio resources
- share radio resources between GPRS and circuit switched use
- handle signalling between the MS, BTS and Serving GPRS Support Node

2.2 Pooling Concept

[Reference no: 1/287 01-FGB 101 256 Uen Rev A 2006-08-23]

Traditionally in GPRS-based packet data networks, each SGSN is wholly responsible for its own service area. If the SGSN becomes unavailable for any reason, subscribers in the service area no longer have access to packet data services. SGSN Pool – which is standardized for GSM and WCDMA networks in 3GPP R5 –addresses this issue by introducing a more flexible and resource-efficient architecture with built-in network redundancy. With SGSN Pool, all the SGSNs in the network work together and the capacity load between them is distributed by the BSCs and RNCs. All BSCs and RNCs serving GSM and WCDMA radio access networks are connected to all SGSNs in the pool, as shown in Fig-2 below. If any SGSN become unavailable, any attached mobile devices will be automatically rerouted to another SGSN in the pool.

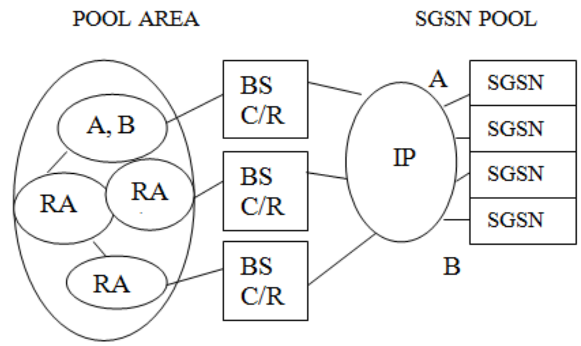

Fig 2: SGSN Pool overview

3. GB OVER IP

3.1 Technical Field of the Invention

This invention relates to telecommunication systems and, more particularly, to a system and method in a General Packet Radio Service (GPRS) network for using a Gb interface, which has been modified to operate using the Internet Protocol (IP), to automatically configure Network Service Entity Identifiers (NSEIs) in a Base Station System (BSS) and a Serving GPRS Support Node (SGSN)

3.2 Description of related art

- The Gb interface is an interface in the GPRS network between the SGSN and the BSS based on the connection-oriented Frame Relay protocol. The protocol stack currently comprises an L1 physical layer (related to Frame Relay), a Network Service (NS) layer, and a Base Station System GPRS Protocol (BSSGP) layer. The NS layer is divided into two sub-layers. The upper NS sub-layer is called the Network Service Control (NSC), and is like the glue with the BSSGP layer above. The lower NS sub-layer is called SubNetwork Service (SNS), and is like the glue with the underlying Frame Relay structure.
- solution is to encapsulate the Frame Relay information in IP packets sent between the two nodes. Also, there are existing networks using the Gb interface over Frame Relay, and any new interface needs to be backward compatible to support these Frame Relay networks. Therefore, the new interface must have a protocol stack that supports both Frame Relay and IP.
- It would be advantageous to have an interface between the BSS and the SGSN that is based on the IP protocol. There is a larger pool of products available for IP than for Frame Relay, and the use of IP allows the use of several different layer 1 and layer 2 technologies (e.g., Frame Relay, Ethernet, fiber optics, etc.). In essence, the Gb interface would become carrier-independent and much more flexible in terms of routing. It would also be easier to maintain.
- Basing the interface on IP would provide additional flexibility and features that exist in IP but not in Frame Relay. For example, an

automatic configuration method would enable BSS components to be changed, or new BSSs to be added to the network while automatically configuring the SGSN to handle the new network configuration. In the existing Frame Relay-based Gb interface, information is carried between the nodes using virtual circuits. These connections must be established manually.

- The SGSN must know in advance which fictional entity is going to be on the other side of each virtual circuit, so when there is a change to the BSS, a technician must physically go to the SGSN and enter the same data that was set up in the BSS. For example, identifying numbers are assigned to each functional entity, and the technician must manually deconflict these numbers by making sure that the numbers that he assigns in the BSS are not already assigned in the SGSN to other entities.

3.3 Transmission plane on GB interface.

Transmission over the Gb interface was based on frame relay. Point-to-point (PTP) physical lines or an intermediate frame relay network were used to connect the SGSN and the BSS.

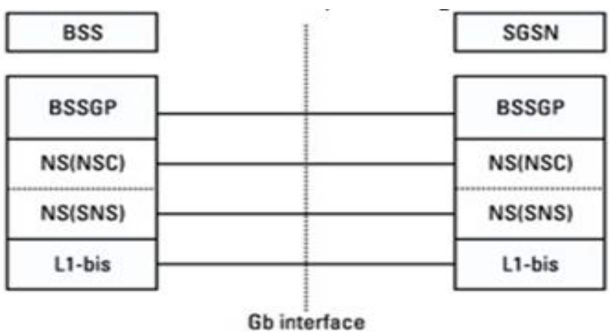

Fig 3: Transmission plane on Gb interface

3.3.1 NS Layer

The NS layer provides a frame-based, multiplexed link layer transport mechanism across the Gb interface that relies on the frame relay protocol. The NS layer has been split into two sublayers, subnetwork service (SNS) and network service control (NSC) in order to make one sublayer independent of the intermediate transmission network. SNS is based on frame relay but NSC is independent of the transmission network. Later, it will be possible to change the transmission network (e.g., with an IP network) without changing the NSC sublayer. Peer-to-peer communication across the Gb interface between the two remote NS entities in the BSS and the SGSN is performed over virtual connections. The NS layer is responsible for the management of the virtual connections between the BSS and the SGSN (verification of the availability of the virtual connections, initialization, and restoring of a virtual connection). It provides information on the status and the availability of the virtual connections to the BSSGP layer. It ensures the distribution of upper-layer PDUs between the different possible virtual connections (load-sharing function). SNS provides access to the intermediate transmission network (i.e., the frame relay network). NSC is responsible for upper-layer data (BSSGP PDUs) transmission, load sharing, and virtual connection management.

3.3.2 BSSGP Principle

The BSSGP layer ensures the transmission of upper-layer data (LLC PDUs) from the BSS to the SGSN or from the SGSN to the BSS. It ensures the transmission of GMM signalling and NM signalling.The peer-to-peer communication across the Gb interface between the two remote BSSGP entities in the BSS and the SGSN is performed over virtual connections. There is one virtual connection per cell at BSSGP layer. Each virtual connection can be supported by several layer 2 links between the SGSN and the BSS. The BSSGP layer is responsible for the management of the virtual connections between the SGSN and the BSS (verification of the availability of the virtual connections, initialization and restoring of a virtual connection). The BSSGP layer also ensures the data flow control between the SGSN and the BSS. There is a one-to-one relationship between the BSSGP in the SGSN and in the BSS. That means if one SGSN handles several BSSs, the SGSN must have one BSSGP protocol machine for each BSS. Figure-4 shows the position of the BSSGP layer within the BSS and the SGSN.

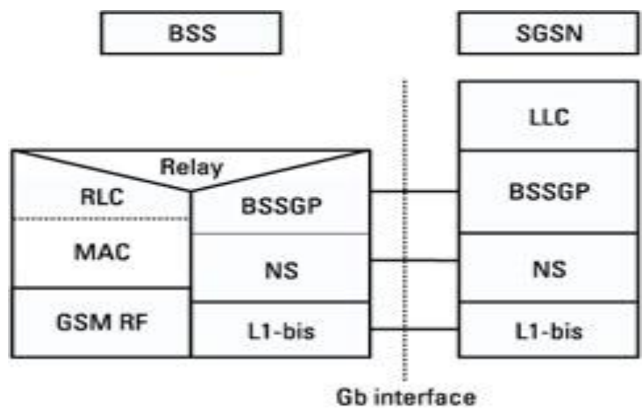

Fig 4: Position of the BSSGP layer within the BSS and SGSN

4. CONCLUSION

- The present invention uses a Gb-over-IP interface (Gb′) between the SGSN and the BSS to implement an automatic "plug and play" configuration methodology. The Gb′ interface implements a protocol stack in the SGSN and the BSS that includes a User Datagram Protocol (UDP) layer over an IP layer. Data packets are then transmitted between the BSS and the SGSN over a connectionless IP network. The data packets carry information between functional entities in the SGSN and functional entities in the BSS.
- The protocol stack includes a Base Station System GPRS Protocol (BSSGP) protocol layer that provides radio-related, Quality-of-Service (QoS), and routing information that is required to transmit user data between the BSS and the SGSN. The stack also includes a modified Network Services (NS′) layer which is divided into an upper NS′ Network Service Control (NS′-NSC) sub-layer and a lower NS′-Sub-Network Service (NS′-SNS) sub-layer. The NS′-NSC sub-layer maps to the BSSGP layer and manages functional entities therein. The NS′-SNS sub-layer

maps to the UDP and IP layers and provides access to the IP network. A single UDP port is reserved to make the NS′ layer and the BSSGP layer act as an application over the IP stack.

- The system and method of the present invention automatically configures Network Service Entity Identifiers (NSEIs) in the BSS and the SGSN when the BSS is reconfigured. The BSS utilizes the Gb-over-IP interface to automatically send a request for an NSEI from the BSS to the SGSN whenever a new Network Service Entity (NSE) is added to an existing BSS. Whenever a new BSS is added to the network, the new BSS automatically sends a request for an NSEI to the SGSN. The SGSN then allocates a free NSEI, and sends the allocated NSEI from the SGSN to the BSS. The allocated NSEI is recorded in the BSS and the SGSN. The NSEI may be dynamically allocated from a pool of free NSEIs in the SGSN.
- The system and method of the present invention also automatically de-allocates NSEIs when an NSE is removed from the BSS. In this aspect, the BSS automatically sends a request from the BSS to the SGSN to free an NSEI whenever an NSE is removed from the BSS. The SGSN de-allocates the NSEI, and returns the NSEI to the pool of free NSEIs.

One of the key trends in mobile communications today is the rapid growth in the number of data users. At the same time, a host of new data-oriented services are being introduced that require real-time performance, including IP Telephony. These trends highlight the need to improve data network efficiency to ensure right service quality and superior user experience. The quality of user experience is defined not only by the applications available, but also by network factors such as availability and resource utilization. Thus the implementation of the Gb link between the BSS and SGSN in the GPRS network using IP helps mobile operators to meet these changing demands. This can be achieved through increased capacity utilization, network-level redundancy, efficient mobility and simplified O&M. The results are improved customer satisfaction, and lower churn, twinned with better profitability through lower capital and operational expenditure.

4.2 Future Scope

GPRS Phase 2 development includes the following features:

- IP and X.25 interfaces to packet data network.
- Static and dynamic IP address allocation.
- Anonymous access.
- Security i.e. authentification and ciphering

5. ACKNOWLEDGEMENT

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